

# Discrete Mathematics and Probability

## Lecture 1

### Welcome to the Course

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School of Informatics  
The University of Edinburgh

Monday 15 September 2025

# Welcome to DMP

## Discrete Mathematics and Probability

This is a second-year undergraduate course for students in the School of Informatics.

The course covers topics fundamental across informatics: sets, numbers, functions, relations, methods of proof, counting methods, probability, random variables, distributions, and statistics.

Many of you will recognize some of this material and be confident in using it; for everyone some part will be new. The aim is that end of the course all of you will be capable in working across all the topics covered.

**Lectures** Mondays and Thursdays 1410–1500

**Study Guides** Reading and short videos released online weekly

**Tutorials** Tuesdays and Wednesdays, starting in Week 2

**Coursework** Weekly online quizzes and written homework

**Exam** Final 2-hour written exam in December

# DMP Course Lecturers



Rob van Glabbeek



Markulf Kohlweiss



Ian Stark



Heather Yorston

# Resources

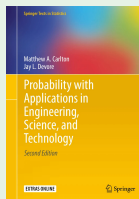
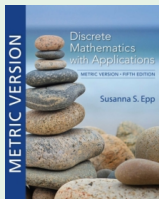
## Lectures



## Tutorials



## Textbooks



## Study Guides

### 1.3 Relations and Functions

Chapter 1 Section 1.3 in the Epp textbook is the Introduction to Relations and Functions; in Levin look at Section 0.4. Again you should find the contents familiar from Year 1. The video recaps all the theory.



To check your understanding try some of the following exercises in Epp.

- Exercise 1.3 Questions 1, 3, 7, 9, 13, and 15

Or you could instead try the interactive [Exercises](#) in Section 0.4 of Levin.

# Lectures

**When** 1410–1500 Monday and Thursday every week

**Where** Lecture Theatre C of the 40 George Square Lecture Theatres

Lectures will be streamed live and then available for reviewing. Access is through Learn.



40 George Square Lecture Theatres



Lecture Theatre C

# Tutorials

Tutorials start in Week 2 and run on Tuesdays and Wednesdays.

There are six tutorial groups, with automated allocation to fit with existing timetable commitments. Each group has two assigned tutors.

In the tutorial students work in small groups on a problem sheet for the week. There is also opportunity to review homework exercises and discuss with tutors.

If you are unable to attend your assigned tutorial group one week then please go to one of the other groups, telling the tutor there when you arrive.

If you wish to switch to a different tutorial group then please submit a [Group Change Request](#) through the *Personalized Timetable* section of the Timetabling website.



# Textbooks

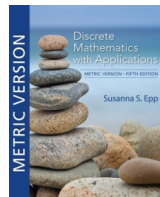
The University Library has paid for students to have access to both course textbooks. Visit *Library Resources* in Learn to use them.



**Susanna S. Epp**

Discrete Mathematics with Applications

Fifth Edition, Metric Version. Cengage, Australia.



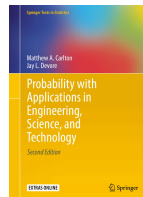
**Warning:** Do not use the “Download” option: this limits access by other students for 24 hours. Instead always choose “Read Online”.



**Matthew A. Carlton and Jay L Devore**

Probability with Applications

Second Edition. Springer International.



The library provides PDF and EPUB versions to download.

# Some Generally Helpful Practices



Be precise and correct.

Second order precision: know when you are being precise, and to what degree; know when it matters to be precise; know when it does not.

“We demand rigidly defined areas of doubt and uncertainty” — *Vroomfondel*  
The Hitchhikers Guide to the Galaxy, Douglas Adams  
<https://is.gd/deepthought>

Be prepared to code switch: is set complement  $A^c$  or  $\overline{A}$  or ...?

## Postel's Law

RFC 761

### 2.10. Robustness Principle

TCP implementations should follow a general principle of robustness: be conservative in what you do, be liberal in what you accept from others.



# Weekly Study Guides

## Study Guides

### 1.3 Relations and Functions

Chapter 1 Section 1.3 in the Epp textbook is the introduction to Relations and Functions; in Levin look at Section 0.4. Again you should find the contents familiar from Year 1. The video recaps all the theory.

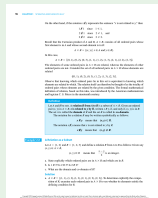
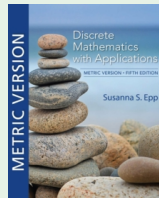


To check your understanding try some of the following exercises in Epp.

- Exercise 1.3 Questions 1, 3, 7, 9, 13, and 15

Or you could instead try the interactive Exercises in Section 0.4 of Levin.

## Reading



## Videos

Q3: Write down the set  $F$  of factors of 24

$$F = \{1, 2, 3, 4, 6, 8, 12, 24\}$$

Q4: Write down the set  $P$  of prime numbers  $< 14$

$$P = \{2, 3, 5, 7, 11, 13\}$$

We can use **set builder** notation by stating the property/properties of the members

$$F = \{x \mid x \text{ is an even positive integer less than } 10\}$$

*such that or:*

is a member of  $\in$  is not a member of  $\notin$

Q5: Write down the set  $S$  of prime factors of 24

Q6: Write down the set of positive even numbers



## Exercises

### EXERCISE SET 1.3

- Let  $A = \{2, 3, 4\}$  and  $B = \{6, 8, 10\}$  and define a relation  $R$  from  $A$  to  $B$  as follows: For every  $(x, y) \in A \times B$ ,

$(x, y) \in R$  means that  $\frac{y}{x}$  is an integer.

- Is  $4 R 6$ ? Is  $4 R 8$ ? Is  $3 R 6$ ? Is  $3 R 8$ ? Is  $2 R 6$ ? Is  $2 R 8$ ?
- Write  $R$  as a set of ordered pairs.
- Write the domain and co-domain of  $R$ .
- Draw an arrow diagram for  $R$ .

- Let  $C = D = \{-3, -2, -1, 1, 2, 3\}$  and define a relation  $S$  from  $C$  to  $D$  as follows: For every  $(x, y) \in C \times D$ ,

$(x, y) \in S$  means that  $\frac{y}{x} - \frac{1}{2}$  is an integer.

- Is  $3 S 2$ ? Is  $-1 S -1$ ? Is  $1 S 3$ ? Is  $3 S 3$ ?
- Is  $(-3, -3) \in S$ ?
- Write  $S$  as a set of ordered pairs.
- Write the domain and co-domain of  $S$ .
- Draw an arrow diagram for  $S$ .

- Write the domain and co-domain of  $V$ .
- Draw an arrow diagram for  $V$ .

- Define a relation  $S$  from  $\mathbb{R}$  to  $\mathbb{R}$  as follows:

For every  $(x, y) \in \mathbb{R} \times \mathbb{R}$ ,

$(x, y) \in S$  means that  $x \geq y$ .

- Is  $(2, 1) \in S$ ? Is  $(2, 2) \in S$ ? Is  $2 S 3$ ?
- Is  $(-1) S (-2)$ ?

- Draw the graph of  $S$  in the Cartesian plane.

- Define a relation  $R$  from  $\mathbb{R}$  to  $\mathbb{R}$  as follows:

For every  $(x, y) \in \mathbb{R} \times \mathbb{R}$ ,

$(x, y) \in R$  means that  $y = x^2$ .

- Is  $(2, 4) \in R$ ? Is  $(4, 2) \in R$ ? Is  $(-3) R 9$ ?
- Is  $9 R (-3)$ ?

- Draw the graph of  $R$  in the Cartesian plane.

- Let  $A = \{4, 5, 6\}$  and  $B = \{5, 6, 7\}$  and define relations  $R$ ,  $S$ , and  $T$  from  $A$  to  $B$  as follows: For every  $(x, y) \in A \times B$ :

# More Ways to Learn

## Quizzes

### Question 1

Not yet answered  
Marked out of 1.00  
Flag question

Let  $X$  be the number of flights that, on any given day, arrive late at Edinburgh Airport. It is estimated that  $X$  has the probability distribution function  $p$  shown here.

$x$	0	1	2	3
$p(x)$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{6}$

Find the expected value of  $X$  and  $X^2$ , and hence find the variance of  $X$ . Give your answers as fractions.

$$E(X) = \text{[ ]}$$

$$E(X^2) = \text{[ ]}$$

$$V(X) = \text{[ ]}$$

## Homework Exercises

### Question 1

A biscuit factory has three machines used to pack biscuits into large boxes that are then sent out to supermarkets. The machines are labelled A, B, and C, and every day each machine packs many boxes of biscuits. The machines work at different speeds: from all the boxes produced on a given day 40% were packed by A, another 40% by B, and the remaining 20% by machine C.

Some biscuits break during the packing process, which is a problem. Machine A does this quite a lot: for any box packed by A there is a probability 0.1 that it contains some broken biscuits. Machine B is better, with a probability 0.03 that a box from that machine will contain some broken biscuits. Machine C is best of all, with a probability of just 0.01 that a box it packs will have some broken biscuits. All of these probabilities are independent for every box.

Before the boxes are sent out from the factory a few are picked out at random and checked to see whether they contain any broken biscuits.

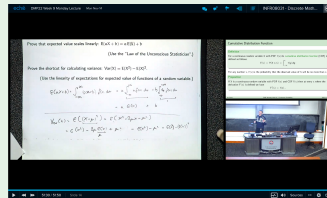
1.1 What is the probability that a box contains some broken biscuits?

1.2 One of the boxes being checked does contain broken biscuits. What is the probability that it was packed by machine B?

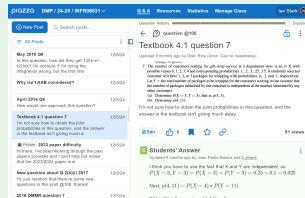
For each part include your working as well as the final answer. State any important results that you use in your calculation.

[7 marks]

## Recordings



## Piazza



# Online Quizzes

Weekly online quizzes are released on Thursdays for completion by noon on the following Thursday. Quizzes run on STACK/CodeRunner, reached through Learn.

Quizzes on STACK are randomized: every student sees the same questions, but with different values and answers.

Once starting a quiz you have 60 minutes to complete it. You are allowed up to two attempts and keep the highest mark. Students with additional time in exams also get more time to complete each quiz. There are no extensions or adjustments for late submission.

The online STACK tool provides automatic marking and custom feedback for each submission: if you get a question wrong then the tool explains why, and after your final submission it sets out a correct answer.

There are ten quizzes to complete: the highest eight marks contribute to final course grades.

# Homework Exercises

Weekly homework exercises are released on Thursdays for completion by noon on the following Thursday. Submission is by upload to GradeScope, reached through Learn. There are no extensions or extra time adjustments for weekly exercises.

If you are unable to complete one week's homework then submit what you have and move on.  
This will not affect your final course grade.

Submissions are marked by tutors and returned with comments in time for your next tutorial where you can discuss your work with each other and the tutors.

There are six homework exercise sets:

Discrete Mathematics Weeks 2, 3, and 4

Probability Weeks 8, 9, and 10

# Weekly Timetable

Thursday 1410–1500 Lecture and release of study guide, videos, homework, online quizzes

Monday 1410–1500 Lecture

Tuesday, Wednesday Tutorials

Thursday 1200 Deadline for completion of online quizzes and upload of homework solutions

Thursday 1410–1500 Lecture

This course accounts for  $\frac{1}{3}$  of your academic credit this semester and you should plan to spend on it a correspondingly substantial fraction of your study time. I recommend a baseline of *at least 10 hours each week* across in-person activities, studying, and coursework.

## Final Exam

- Two-hour written paper in an exam hall.
- (Some students receive additional time or sit in a different room.)
- Part A: Discrete Mathematics. Four questions, total 50 marks.
- Part B: Probability. Four questions, total 50 marks.

Results of the written exam and the weekly online quizzes are combined in ratio 4:1 to give a weighted mean mark and final grade for the course. The overall pass threshold is 40/100 and there is no “force-fail” or requirement to pass any component individually.

(Written Exam: 80%; Online Quizzes: 20%)

A resit examination in August 2026 offers a complete retest of all material in the course.

## Summative Assessment

- Assessment *of* Learning.
- Certifies how well you know some things and can perform some tasks.
- Determines final marks and grades. (“For credit”)
- Tax.

## Formative Assessment

- Assessment *for* Learning.
- Feedback: identifies what you do and don't know or can do; helps improvement.
- No risk to final marks or grades.
- Investment.

# Collaboration, Cooperation, and Consultation

Anything submitted for summative assessment must be your own unaided work. In DMP, this means the weekly online quizzes and the final written exam: these you should do without help from others.

Please remember the good scholarly practice requirements of the University regarding work for credit. You can find guidance at the School page

<https://informatics.ed.ac.uk/taught-students/all-students/your-studies/academic-misconduct>

This also has links to the relevant University pages.

For other coursework — tutorial exercises, weekly homework, study guides, textbook readings — you are free to consult with others, ask questions on Piazza and in lectures, discuss your ideas on solutions. Please do!



# Collaboration, Cooperation, Consultation, and Generative AI

Anything submitted for summative assessment must be your own unaided work. In DMP, this means the weekly online quizzes and the final written exam: these you should do without help from others: including Generative AI, Large Language Models (LLMs), chatbots, and the like.

Please read the guidance for working with Generative AI in your studies, linked from the school guidance page

<https://informatics.ed.ac.uk/taught-students/all-students/your-studies/academic-misconduct>

Note in particular the section on *Cognitive Offloading*. This can be a particular concern when you are trying to learn new skills or techniques: where the aim of an activity is not to obtain a final result but instead to gain experience in carrying out a challenging task.

# Course Syllabus

## Discrete Mathematics

Weeks 1–5: Rob van Glabbeek

Logic and set theory; proof by cases, counterexamples, contraposition, and contradiction; integers, rationals, and divisibility; sequences and sums; mathematical induction; functions and relations; cardinality; modular arithmetic and cryptography.

## Probability

Weeks 7–11: Markulf Kohlweiss, Ian Stark

Counting and sampling; conditional probability; Bayes' Theorem; random variables; probability distributions; density functions; discrete vs. continuous probability; normal distribution; covariance and correlation; Central Limit Theorem.

# What To Do Next

- Log in to DMP on Learn through MyEd or directly at <https://www.learn.ed.ac.uk>.
- Follow the Week 0 to-do list there.
- Visit the course web pages at <https://opencourse.inf.ed.ac.uk/dmp>.
- Follow the Week 1 Study Guide there.
- Complete the Week 1 Online Quiz (access through Learn as STACK: Online Quizzes).
- Attend Thursday's lecture at 1400 here in 40 George Square Lecture Theatre C.

**Any Questions?** Raise your hand or come up to the front at the end of the lecture.